In this regard, Claim 62 has been amended to depend from allowed Claim 15, and is therefore believed in condition for allowance also.

The rejection of the remaining claims as anticipated by the cited art respectfully is traversed. Nevertheless, without conceding the propriety of the rejection, Claims 1, 2, 13, 14, 60, 61, 65, 75, 86, 89 and 91 to 95 have been amended more clearly to recite various novel features of the present invention. Support for the proposed amendments may be found in the original application. No new matter has been added.

Newly presented Claims 94 to 97 have been added to provide Applicant with an additional scope of protection commensurate with the disclosure. Support for these newly presented claims also may be found in the original application. No new matter has been added.

The present invention relates to a novel vibration member, e.g., for use in a vibration wave driving apparatus. The vibration member generally comprises an elastic member and an electro-mechanical energy conversion element in contact with the elastic member, which generates a driving vibration in a driving portion of the elastic member.

In one aspect, as variously recited in each of independent Claims 1, 2, 13, 14, 94 and 95, the present invention relates to a feature wherein a rigidity/sectional area/density of portions of the elastic member which are located between adjacent protrusions and which also are located between adjacent electrodes is larger than a rigidity/sectional area/density of other portions of the elastic member which are located between adjacent protrusions but which are not also located between adjacent electrodes.

In another aspect, as generally recited in independent Claims 91 and 92, the present invention relates to a feature where a rigidity or sectional area of portions of the

elastic member which are located at positions of the protrusions and which also are located between adjacent electrodes is larger than a rigidity of other portions of the elastic member which are located at positions of the protrusions but which are not also located between adjacent electrodes.

As discussed in greater detail in the present application, each of these aspects/features provides a significant improvement over the prior art, in that differences in the modulus of elasticity profile generated by the polarization process of the electro-mechanical energy conversion element may be offset or compensated for.

Applicants submit that the prior art fails to anticipate the present invention. Moreover, Applicants submit that there are differences between the subject matter sought to be patented and the prior art, such that the subject matter taken as a whole would not have been obvious to one of ordinary skill in the art at the time the invention was made.

The Tobe '670 patent relates to a vibration actuator, and discloses an actuator including reduced rigidity portions formed in the elastic body. The Tobe '670 patent also discloses driving protrusions 11a and 11b which may correspond to the driving portion comprising a plurality of protrusions in the present application, and further discloses boundary portions between respective piezoelectric members 12a, 12b, 12p and 12p′ which may correspond to portions of the present invention located between adjacent protrusions. However, Applicant submits that the Tobe '670 patent fails to disclose or suggest at least the above-described features of the present invention. Rather, in the Tobe '670 patent, among portions of the elastic member located between driving protrusions 11a and 11b, the rigidity or sectional area of portions other than portions at which the grooves 13b and 13c are provided, are uniform. Hence, the rigidity or sectional area of portions

located between driving protrusions 11a and 11b and also located at a position between adjacent electrodes, may be equal to that of a portion located between driving protrusions 11a and 11b but not located at a position between adjacent electrodes. Thus, Applicant submits that the Tobe '670 patent fails to disclose or suggest at least the features recited in independent Claims 1, 2, 13 and 14.

The Tobe '670 patent further discloses that electrodes are formed at positions located between two protrusions. Accordingly, Applicant submits that the Tobe '670 patent fails to disclose or suggest the claimed features with respect to portions located at positions of the protrusions and located at positions which are located between adjacent electrodes, as disclosed and claimed in the present application (Claims 91 and 92).

The Fujimoto '598 patent relates to a vibration driven device, and discloses a device including a plurality of projected portions. However, Applicant submits that the Fujimoto '598 patent fails to disclose or suggest at least the above-described features of the present invention. Rather, the Fujimoto '598 patent discloses an arrangement in which each end portion of the plurality of electrodes of the conversion element is located coincident with one of the plurality of projection portions of the vibration member. Applicant submits that the Fujimoto '598 patent fails to disclose or suggest at least the above recited features with respect to independent Claims 1, 2, 13 and 14.

Further, in the Fujimoto '598 patent apparatus, the shapes of all of the plural protrusions are the same. Hence, the rigidity for a sectional area of portions of the elastic member located at positions of the protrusions and also located at positions between adjacent electrodes may be equal to the rigidity or sectional area of other portions that are located at a position of a protrusion but are not located between adjacent electrodes.

Accordingly, Applicant submits that the Fujimoto '598 patent fails to disclose the above-discussed features of independent Claims 91 and 92.

The Tsukada '186 patent relates to an ultrasonic motor, and discloses an ultrasonic motor including a vibration member having a plurality of protrusions. However, Applicant submits that the Tsukada '186 patent fails to disclose or suggest at least the above-described features of the present invention. In Tsukada '186 apparatus, the shapes of all the plural projections are the same, and the shape of the recesses also are the same. Some of the projections and recesses are located at positions between two electrodes, and some of the projections and recesses are not located at positions between two electrodes. Hence, the rigidity or sectional area of a portion located at a position of a groove and also located at a position between two electrodes may be equal to the rigidity or sectional area of a portion located in a groove and also located at a position between adjacent electrodes. Accordingly, Applicant submits that the Tsukada '186 patent fails to disclose or suggest at least the above-described features of independent Claims 1, 2, 13 and 14. Nor does the Tsukada '186 patent disclose or suggest the above-recited features of independent Claims 91 and 92.

Applicant also submits that the prior art of record fails to disclose or suggest the recited features relating to the density of an elastic member; accordingly, Applicant submits that Claims 3, 15, 94 and 95 are allowable over the cited art.

Applicant further submits the prior art fails to disclose or suggest the claimed features relating to the width in the radial direction, between electrodes of the electro-mechanical energy conversion element; accordingly, Applicant submits that Claim 89 also is allowable over the prior art of record.

For the above reasons, Applicants submit that independent Claims 1 to 3, 13, 14, 91 and 92 are allowable over the cited art.

Claims 57, 58, 60, 61, 63 to 65, 67, 68, 70, 71, 73, 75, 78, 79, 81, 82, 84, 86, 89, 93, 96 and 97 depend from Claims 1 to 3, 13 to 14 and 92, respectively, and are believed allowable for the same reasons. Moreover, each of these dependent claims recites additional features in combination with the features of its respective base claim, and is believed allowable in its own right. Individual consideration of the dependent claims respectfully is requested.

Applicant believes that the present Amendment is responsive to each of the points raised by the Examiner in the Official Action, and submits that the application is in allowable form. Favorable consideration of the claims and passage to issue of the present application at the Examiner's earliest convenience earnestly are solicited.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

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MARKED-UP VERSION SHOWING CHANGES TO THE CLAIMS

1. (Three Times Amended) A vibration member comprising:

an elastic member including a driving portion having a plurality of protrusions; and

an electro-mechanical energy conversion element in contact with said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a rigidity of portions of said elastic member which are located between adjacent protrusions and which also are located between adjacent [said plurality of] electrodes is [set] larger than a rigidity of other portions of said elastic member which are located between adjacent protrusions but which are not also located between adjacent electrodes [so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element].

2. (Three Times Amended) A vibration member comprising:

an elastic member including a driving portion; and

an electro-mechanical energy conversion element in contact with said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a cross-sectional area of portions of said elastic member which are located between adjacent protrusions and which also are located between adjacent [said plurality] electrodes is [set] larger than a cross-sectional area of other portions of said elastic member which are located between adjacent protrusions but which are not also located between adjacent electrodes [so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element].

3. (Twice Amended) A vibration member comprising:

an elastic member including a driving portion; and

an electro-mechanical energy conversion element in contact with said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process

of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a density of portions of said elastic member located between said plurality of electrodes is set higher than a density of other portions of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element.

13. (Three Times Amended) A vibration member having an annular or disc shape, comprising:

an elastic member including a driving portion having a plurality of protrusions, and having an annular or disc shape; and

an electro-mechanical energy conversion element having an annular shape and bonded to one surface of said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to the electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the

plurality of vibrations generates a driving vibration in said driving portion,

wherein a rigidity of portions of said elastic member which are located between adjacent protrusions and which also are located between adjacent [said plurality of] electrodes is [set] larger than a rigidity of other portions of said elastic member which are located between adjacent protrusions but which are not also located between adjacent electrodes [so as to offset differences in the modulus of elasticity generated by the polarization process of said electro-mechanical energy conversion element].

14. (Three Times Amended) A vibration member having an annular or disc shape, comprising:

an elastic member including a driving portion having a plurality of protrusions, and having an annular or disc shape; and

an electro-mechanical energy conversion element having an annular shape and bonded to one surface of said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a cross-sectional area of portions of said elastic member which are located between adjacent protrusions and which also are located between adjacent [said plurality of] electrodes is [set] larger than a cross-sectional area of other portions of said elastic member which are located between adjacent protrusions but which are not also located between adjacent electrodes [so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element].

15. (Twice Amended) A vibration member having an annular or disc shape, comprising:

an elastic member including a driving portion, and having an annular or disc shape; and

an electro-mechanical energy conversion element having an annular shape and bonded to one surface of said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to the electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a density of portions of said elastic member located between said plurality of electrodes is set higher than a density of other portions of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element.

17. (Twice Amended) A vibration member comprising:

an elastic member including plural elastic member portions and a driving portion; and

an electro-mechanical energy conversion element held and fixed between said plural elastic member portions, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion of said elastic member,

wherein the rigidity of portions of said elastic member located between adjacent electrodes of said plurality of electrodes having different directions of polarization from each other is set larger than the rigidity of other portions of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element.

18. (Twice Amended) A vibration member comprising:

an elastic member including plural elastic member portions and a driving portion; and

an electro-mechanical energy conversion element held and fixed between said plural elastic member portions, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving-vibration in said driving portion,

wherein portions of said elastic member located between said plurality of electrodes are cut out so as to offset differences in the modulus of elasticity generated by the polarization process of said electro-mechanical energy conversion element.

57. (Amended) A vibration wave driving apparatus including said vibration member according to Claim 1 and a contact member in press contact with said vibration member and movable relative to said vibration member by the driving force of said driving portion.

58. (Amended) A vibration wave driving apparatus including said vibration member according to Claim 2 and a contact member in press contact with said vibration member and moveable relative to said vibration member by a driving force of said driving portion.

59. (Amended) A vibration wave driving apparatus including said vibration member according to Claim 3 and a contact member in press contact with said vibration member and moveable relative to said vibration member by a driving force of said driving portion.

60. (Twice Amended) A vibration wave driving apparatus including said vibration member according to Claim 13 [15] and a contact member in press contact with said vibration member and moveable relative to said vibration member by a driving force of said driving portion.

61. (Twice Amended) A vibration wave driving apparatus including said vibration member according to Claim 14 [13] and a contact member in press contact with said vibration member and moveable[,] relative to said vibration member by a driving force of said driving portion.

62. (Twice Amended) A vibration wave driving apparatus including said vibration member according to Claim 15 [14] and a contact member in press contact with said vibration member and moveable[,] relative to said vibration member by a driving force of said driving portion.

63. (Amended) A vibration wave driving apparatus including said vibration member according to Claim 1 and a contact member in press contact with said vibration member through a fluid, said contact member being moveable relative to said vibration member by a driving force of said driving portion.

64. (Amended) A vibration wave driving apparatus including said vibration member according to Claim 13 and a contact member in press contact with said vibration member through a fluid, said contact member being moveable relative to said vibration member by a driving force of said driving portion.

65. (Twice Amended) A vibration wave driving apparatus including said vibration member according to Claim 2 [14] and a contact member in press contact with said vibration member through a fluid, said contact member being moveable relative to said vibration member by a driving force of said driving portion.

75. (Amended) A vibration member according to Claim 2, wherein among grooves which are formed between adjacent protrusions, those grooves which also are located at positions between adjacent electrodes are more shallow than the other grooves [said elastic member has a plurality of grooves for enlarging displacement of said driving portion, and a groove for enlarging displacement located between said plurality of electrode is set shallower than other of the plurality grooves for enlarging displacement].

76. (Amended) A vibration member according to Claim 3, wherein said elastic member is made of a material having pores, and a number of the pores in a portion of said elastic member located between said plurality of electrodes is set less than that in other portions of said elastic member.

86. (Amended) A vibration member according to Claim 14, wherein among grooves which are formed between adjacent protrusions, those grooves which also are located at positions between adjacent electrodes are more shallow than the other grooves [said elastic member has a plurality of grooves for enlarging displacement of said driving portion, and a groove for enlarging displacement located between adjacent electrodes of said electrodes is set shallower than other grooves for enlarging displacement].

90. Cancelled.

91. (Amended) A vibration member comprising:

an elastic member including a driving portion[, and] having a plurality of protrusions [an annular or disc shape]; and

an electro-mechanical energy conversion element in contact with [having an annular shape and bonded to one surface of] said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a rigidity of portions [a portion] of said elastic member which are located at positions of said protrusions and which also are [adjacent to a portion] located between adjacent electrodes [of said plurality of electrodes] is [set] larger than a rigidity of other portions of said elastic member which are located at positions of said protrusions but which are not also located between adjacent electrodes [so as to offset differences in the modulus of elasticity profile generated by the polarization treatment of said electro-mechanical energy conversion element].

92. (Amended) A vibration member comprising:

an elastic member including a driving portion[, and] having a plurality of protrusions [an annular or disc shape]; and

an electro-mechanical energy conversion element in contact with [having an annular shape and bonded to one surface of] said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes, a corresponding plurality of polarized regions formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process profile, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a cross-sectional area of portions [a portion] of said elastic member which are located at positions of said protrusions and which also are [adjacent to a portion] located between adjacent electrodes [of said plurality of electrodes] is [set] larger than that of other portions of said elastic member which are located at positions of said protrusions but which are not also located between adjacent electrodes [so as to offset differences in the modulus of elasticity generated by the polarization process of said electro-mechanical energy conversion element].

93. (Amended) A vibration member according to Claim 92, wherein among grooves which are formed between adjacent protrusions, those grooves which also are located at positions between adjacent electrodes are more shallow than the other grooves [said elastic member has a plurality of grooves for enlarging displacement of said driving portion, and a groove for enlarging displacement located between adjacent electrodes of said plurality of electrodes is set shallower than other grooves for enlarging displacement].